Prices, Real Value Added and Productivity in Dutch Manufacturing, 1921-1960

Research Memorandum 549 (GD-4)

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October 1993

Memorandum from
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* Research memoranda of the Groningen Growth and Development Centre are published as a sub-series of the memorandum series of the Institute of Economic Research.

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Abstract

This paper describes the results of a study on prices, real output and productivity for the Dutch manufacturing sector in the period 1921-1960. Use was made of the production statistics: an annual survey by the Dutch Central Bureau of Statistics of important manufacturing industries. The frequency of the survey allows us to construct time series for gross value added, input and output prices, and productivity by major group of industry. To deflate output and input values specific long term price indexes were constructed, based on the industry-of-origin method. Double and single deflated time series of gross value added and productivity are constructed and analysed.[1]

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[1] I would like to thank Gert den Bakker of the CBS for kindly letting me use his estimates on gross value added in Dutch manufacturing in the interwar years. I am grateful to Bart van Ark, Rainer Fremdling, Angus Maddison, Dirk Pilat and participants in the 22nd General Conference of IARIW (Flims, September 1992) for giving me very helpful comments and suggestions. René Oude Vrielink assisted with some of the statistical work and the graphs.

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1. Introduction

In the field of economic history more and more effort is being put into the compilation of a quantitative framework for description and analysis of economic development before the Second World War. Such quantification is indispensable for comparative economic history, and for analysis of processes of divergence and convergence. One of the major fields within this kind of research is the study of levels and growth of sectoral output and productivity. Most recent studies on comparative output and productivity before the Second World War are based on the pioneering work of Rostas[1] and focus on comparisons between countries of output and productivity in manufacturing industry for a limited number of benchmark years.[2] For the postwar period, statistical sources for comparisons are more readily available. Recently Van Ark compared the performance of manufacturing industries in ten western and non western countries for the period 1950-1990.[3] Although the present article aims to link up with the sectoral approach of output and productivity measurement, its purpose is not to compare different countries. Instead it provides a quantitative description of the long term development of output and productivity in Dutch manufacturing between 1921 and 1960. Real indicators are presented on an annual basis and several methods of deflation are used to establish output and productivity values in constant prices.

Until recently little was known about the performance of manufacturing industry in the Netherlands during the interwar period. The Dutch Central Bureau of Statistics has published several general indexes for the period 1921-1938, based on different indicators such as physical inputs or outputs. In these indexes, weighting schemes are defined by the relative size of employment.[4] In 1947 Keesing published a new series based on the so-called Produktiestatistiek, the Dutch census of production.[5] Use was made of output

values of the manufacturing industries mentioned in the survey. To obtain an index of real gross output (in constant prices) Keesing deflated the production values with a wholesale price index. A major improvement occurred in 1987 when Seegers calculated 14 indexes of different branches, mainly based on physical indicators, but partly also on output values from the Dutch production statistics.[6] Finally, Van Zanden and Griffiths published several indexes of manufacturing output which slightly revised the CBS data.[7] A comparison between all indexes reveals similar growth patterns for the twenties but large differences for the depression years from 1930 onwards. These are mainly caused by differences in classification schemes (sometimes construction and mining were added to manufacturing industry) and by differences in indicators (physical quantities versus output values). However, none of these indexes is based on the, nowadays, widely accepted approach of measuring output in terms of value added, which is the difference between the value of output minus costs of inputs and intermediate products. Data on inputs and outputs are more easily obtainable and more homogeneous for the postwar period. After the war the CBS gradually extended the number of indicators (which were partly based on physical quantities and partly on output values).[8] Partial indexes of manufacturing branches were weighted with the value added shares of the different branches. Unfortunately, because of changes in products and in classification and of changes in weighting schemes, it is very difficult to link the postwar indexes of the individual branches with the prewar indexes.

The aim of the present study is to tackle the problem of output measurement by sector using the value added concept instead of physical indicators. The problem of the continuity is also dealt with by linking the prewar and postwar output series. The central source providing the statistical data is the annual survey of manufacturing by the Dutch Central Bureau of Statistics, the Produktiestatistiek. These surveys not only provide information on output and value added but also on employment. They allow us to establish indexes of output and productivity from one and the same source. However, the available indexes of manufacturing productivity in the interwar period are difficult to interpret and to combine, because information on output and employment are based on various sources and do not conform the internationally accepted classification standard.[9] As with output, it is not possible to link the prewar productivity indexes to the postwar productivity indexes of the CBS, which are based on the partial output and separate employment

indexes already mentioned.[10] By using the Produktiestatistiek, the measurement of labour productivity can also be extended to the postwar period.

What follows elaborates on several aspects of these surveys which, in fact, form the statistical basis of a larger study on development and structure of Dutch manufacturing industry in the twentieth century. This article is confined to the presentation of some empirical results. Firstly, the production statistics are compared with the outcomes of the (re)constructed national accounts figures. Secondly, the methodology used to calculate value added and productivity in constant prices is explained. Thirdly, the outcomes concerning input and output prices, double and single deflated value added and productivity are presented. For reasons of convenience and brevity the emphasis in this article lies on the aggregate outcomes. It is self-evident that, for further analysis, greater disaggregation is necessary.

2. The Dutch production statistics and the national accounts compared

Dutch production statistics, formally the "Statistiek van Voortbrenging en Verbruik der Nijverheid" (statistics of output and inputs in manufacturing industry) are the major source for output and productivity analysis in the Netherlands. The first survey was made during the First World War for the years 1913 and 1916.[11] This was a deliberate mix of the British and V.S. production census approach (which focusses on the calculation of value added) and the German industrial statistics approach (which provides a great detail on inputs and intermediate products). From 1921 onwards the Dutch statistics appeared annually. This makes it possible to construct consistent time series for industrial inputs and outputs at the sectoral level. Unfortunately, the surveys do not cover all of the manufacturing sector, except for those of 1913 and 1916. Elaborate and time-consuming surveys of this kind were seen by the government as too expensive, and so only the most important industries were covered. However, in the course of time, the coverage of the surveys was gradually expanded. Production statistics were published in the CBS monthly, the Maandschrift.[12] After 1954, the statistics were published separately, summary statistics being published in the annual publications of the Bureau, the Jaarcij-

fers and the Statistical Yearbook of the Netherlands. The extended versions of the production statistics contain information for each group or major group of industry on the following items: number of establishments, quantity and input value of raw materials, energy consumption and intermediate inputs, quantities and gross values of output and sales, total employment and mechanical capacity (motive power). Although the information was collected on an establishment basis, not all establishments were included. Small firms and home industries were left out. Minimum size was sometimes defined by employment, sometimes by gross output. In most cases, however, at least 95% of total gross output of the collected establishment-information was included in the publications. A list of the survey industries is given in Appendix 1.

The Dutch production census is now the most important source of the manufacturing industry estimates in the Dutch input-output tables, on which the national accounts are based. As the forerunner of the production census, the (less complete) production statistics were a major source for the reconstruction of the national accounts from 1921 to 1939. The production statistics have been used in several CBS-publications to calculate gross value added of manufacturing industry in current prices.[13] Nevertheless, there are large differences between the manufacturing industries covered in the survey and the industry total in the national accounts. The composition of the major groups has varied from time to time. This is why I had to split the period 1921-1960 in two sub-periods. The first half (1921-1939), for which Gert den Bakker of the CBS is reconstructing the national accounts, is classified according to the latest international classification standard. The second half (1945-1960) is classified according to an earlier ISIC-standard. For the first period I have listed eleven clusters of major groups. The most important clusters (measured by gross value added) are 20/21 (food, beverages and tobacco) and 33/37 (metal products, [electrical] machinery and transport equipment). In 1921 the share of these groups in total manufacturing was almost 50% and in 1938 61%.

During the depression years between 1931 and 1937, value added in current prices fell sharply for all major groups, except for cluster 20/21. Demand for food products was more stable than for other items such as investment and postponeable consumption. Hence the relative rise of food manufacturing in the thirties. Apart from changes in relative prices, the sector structure of manufacturing industry seems to have been rather stable during these years. The third most important group were textiles, wearing apparel and

footwear (22/24). This cluster was 26% of value added in 1921, but fell to 18% in 1938. After the Second World War these manufacturing groups regained their earlier position.

Table 1

Gross Value Added in Current Market Prices and Labour Force by Branch of Manufacturing 1921 and 1938

SIC-division*		1921 value added in million guilders	1938 value added in million guilders	1921 value added as percentage of total	1938 value added as percentage of total	1938 labour force	1938 percentage of total
20/21	Food, beverages, tobacco	352	508	24.3	35.9	197 559	22.5
22	Textile products	153	111	10.5	7.8	85 057	9.7
23	Wearing apparel, except footwear	185	117	12.7	8.3	104 233	11.9
24	Leather, footwear, leather products	42	35	2.9	2.5	19 608	2.2
25	Wood products and furniture	81	46	5.6	3.2	63 247	7.2
26	Paper and paper products	18	35	1.2	2.5	17 156	2.0
27	Printed matter	82	65	5.6	4.6	48 120	5.5
28/31	Chemicals, petroleum and rubber products	74	81	5.1	5.7	42 075	4.8
32	Building materials, earthenware and glass products	69	43	4.8	3.0	43 933	5.0
33/37	Metal products, machines, electrical machinery and transport equipment	368	356	25.3	25.1	244 773	27.8
38/39	Miscellaneous	28	19	1.9	1.3	13 742	1.5
Total		1452	1416	100	100	879 503	100

* Standard Industrial Classification of the Netherlands

Sources: G.P. den Bakker, 'Beroepscategorieën in de beroepsbevolking 1930 en 1938', Supplement Sociaal-Economische Maandstatistiek 2 (1992) 10-16. and Den Bakker (forthcoming).

In terms of labour force participation, the picture is different. Although clusters 20/21, 22/23 and 33/37 are still important, food, beverages and tobacco were 'only' 22.5% and metal products etc. 27.8%. This indicates that value added per person employed was relatively high in the food sector. It should be noted here, that in the ideal case, what has to be measured is employment per sector and not the labour force per sector. Figures on

unemployment (the difference between labour force and employment) per manufacturing group, however, are not very reliable.

Table 2

Gross Value Added in Current Market Prices and Labour Force by Branch of Manufacturing 1947 and 1960

ISIC-division		1947 value added in million guilders	1960 value added in million guilders	1947 value added as percentage of total	1960 value added as percentage of total	1960 labour force	1960 percentage of total
20/22	Food, beverages, tobacco	1269	2966	26.7	20.8	193 544	15.5
23	Textile products	536	883	11.3	6.1	106 820	8.6
24	Footwear, wearing apparel	407	706	8.6	5.0	125 887	10.1
25/26	Wood products and furniture	222	445	4.7	3.1	70 901	5.7
27	Paper and paper products	148	437	3.1	3.1	29 809	2.4
28	Printed matter	149	679	3.1	4.8	63 886	5.1
29/30	Leather and rubber products (except footwear)	108	238	2.3	1.8	23 453	1.9
31/32	Chemicals and petroleum	333	2083	7.0	14.6	83 224	6.7
33	Building materials, earthenware and glass products	150	522	3.2	3.7	54 338	4.4
34	Basic metals	123	670	2.6	4.7	34 821	2.8
35/36	Metal products and machinery		1590		11.2	192 134	15.4
37	Electrical machinery	1281	1522	27.0	10.7	93 443	7.5
38	Transport equipment		1085		7.6	143 362	11.5
39	Miscellaneous	18	415	0.4	2.9	30 162	2.4
Total		4744	14 241	100	100	1 245 784	100

Sources: CBS (National Accounts), CBS (Population census 31/5/1960)

Table 2 shows the figures for the postwar period. There are fourteen groups instead of eleven. In 1947 the structure of manufacturing industry in terms of gross value added was almost the same as in 1921. From 1947 to 1960, however, some major shifts occurred. First of all the major groups 20/22 food, beverages and tobacco fell in relative terms from 26.7% in 1947 to 22.8% in 1947. Metal products, electrical machinery and transport equipment taken together were by far the largest cluster as well as in the beginning

as in the end of the period mentioned: 29.6% in 1947 and 34.2% in 1960. Although value added of 23/24 (textile products and footwear and wearing apparel) rose considerably between 1947 and 1960, the relative position of these groups was almost halved from 19.9 to 11.2%. Their place was taken in by the chemical and petroleum sector, which augmented its value added from 7.0 to 14.6% of the total. All other groups made progress in nominal terms, but this did not alter their relative position very much. The most important change which can be discerned in the manufacturing industry in the 1950s is the rise of chemicals and petroleum products and the simultaneous relative decline of foodstuffs, textiles, footwear and wearing apparel.

Looking at the distribution of the labour force in 1960, it can be seen that the employment structure was not the same as the value added structure. There were large differences in the value added per person employed between the groups. Again, there are no reliable employment figures on this level of aggregation available. Therefore the labour force statistics of the 1960 population census are used here.

In Tables 3 and 4, coverage ratios are calculated to illustrate the representativeness of the production statistics. These ratios show value added in the production statistics as percentage of the national accounts. Value added at factor cost best represents the industry's relative contribution to total output. This definition is net of price-increasing taxes. However, the statistical data in the production statistics are given at market prices, or more precisely as ex-factory values. Therefore the most practical procedure is to leave indirect taxes embodied in the values of the final products.[14]

A look at the totals in the tables shows that in the years 1921, 1938, 1947 and 1960 the coverage ratio rose from 29.0 to 30.7% and from 35.9 to 44.3%. These differences between the production statistics and the national accounts can be explained by three phenomena. Firstly, the annual survey of the production statistics did not cover all manufacturing industries. At the beginning of the survey only 21 groups of industries were counted. Over time more groups were added. Fifty different industries were counted in 1960. Secondly, the production statistics refer to establishments with a certain minimum size, sometimes defined by the number of people employed and sometimes by the size of physical output. From time to time limits were changed. For instance, in the machinery industry only establishments with 25 workers or more were included in the sample, and after 1950 establishments larger than 49 workers. The reason for redefinition

was the amount of time that could be saved by the Central Bureau of Statistics in calculating the data. The effects of this are that sudden jumps appear in the statistics on inputs, outputs and value added, which are not caused by real or cyclical events, but by redefinitions. Another effect of the prospected exclusion of small-scale industry is an upward bias of apparent labour productivity performance.

Table 3

Coverage Ratios

Rate of Manufacturing Gross Value Added (1921 and 1938) and Employment (1938) in the Production Statistics to the National Accounts

SIC-division		Coverage of production statistics (percentage of value added at current market prices) 1921	1938	Coverage of prod. statistics employment to total labour force (percentage) 1938
20/21	Food, beverages, tobacco	8.2	6.4	7.1
22	Textile products	69.9	85.1	77.3
23	Wearing apparel, except footwear	0.0	26.0	25.6
24	Leather, footwear, leather products	51.5	65.9	76.3
25	Wood products and furniture	0.0	0.0	0.0
26	Paper and paper products	51.9	52.0	32.8
27	Printed matter	0.0	0.0	0.0
28/31	Chemicals, petroleum and rubber products	17.9	19.3	14.2
32	Building materials, earthenware and glass products	0.0	66.0	50.8
33/37	Metal products, machines, electrical machinery and transport equipment	65.4	54.1	38.5
38/39	Miscellaneous	0.0	0.0	0.0
Coverage of all sample industries as percentage of total manufacturing in the national accounts		29.0	30.7	28.4

Sources: CBS (Production Statistics 1921-1960)

The third reason for the observed difference between the production statistics and the

national accounts data is that I have only included those industries which are covered by the survey both prior to and after the war, in order to obtain consistent time-series for the whole period 1921-1960.

Table 4

Coverage ratios

Rate of Manufacturing Gross Value Added (1947 and 1960) and Employment (1960) in the Production Statistics to the National Accounts

ISIC-division		Coverage of production statistics (percentage of value added at current market prices) 1947	1960		Coverage of prod. statistics employment to total labour force (percentage) 1960	
20/22	Food, beverages, tobacco	10.3	8.0		11.1	
23	Textile products	73.6	97.8		86.1	
24	Footwear, wearing apparel	35.4	58.8		46.9	
25/26	Wood products and furniture	0.0	0.0		0.0	
27	Paper and paper products	24.6	46.1		32.5	
28	Printed matter	0.0	0.0		0.0	
29/30	Leather and rubber products (except footwear)	51.4	76.7		61.8	
31/32	Chemicals and petroleum	8.9	5.3		5.9	
33	Building materials, earthenware and glass products	53.0	49.0		40.5	
34	Basic metals	0.0	0.0		0.0	
35/36	Metal products and machinery		96.2		65.3	
37	Electrical machinery	64.8	100	(107.8)	100	(103.5)
38	Transport equipment		81.3		46.5	
39	Miscellaneous	0.0	0.0		0.0	
Coverage of all sample industries as percentage of total manufacturing in the national accounts		35.9	44.3		41.1	

Sources: CBS (Production Statistics 1921-1960)

If the industries which were gradually included in the production statistics after 1950 were

to be taken into account, the coverage ratio for 1960 would rise from 44.3 to 73.0% of total gross value added. Especially chemicals and petroleum (value added in 1960 in the production statistics 2 428 mln guilders) and food, beverages, tobacco (773 mln guilders) would contribute to this increase. This also illustrates the gradual improvement of the survey in terms of coverage of manufacturing industry. The highest coverage ratios for 1921 and 1938 were found in the major groups 22 (textiles), 24 (leather, footwear), 26 (-paper), 32 (building materials) and in the cluster 33/37 (metal products, [electrical] machinery, and transport equipment). Two of these major groups (22 and 33/37) were also among the largest in manufacturing industry. The largest major group 20/21 (food, beverages, tobacco), however, was poorly covered by the survey. Some groups (25 wood products and 27 printed matter) were not covered at all. The coverage of the total labour force in 1938 (interpolated from the population censuses of 1930 and 1947) shows the same pattern. The percentages are, with the exception of two, lower than the percentages of gross value added. This does not necessarily indicate that the labour productivity of the survey-industries (defined as the gross value added per person employed) was higher than the average of all the manufacturing industries in the national accounts. What is measured in the production statistics is real employment, whereas the total is based on an interpolated labour force estimate.

After the war coverage of the survey increased further, not so much because new groups were added, but because of higher coverage ratios, especially for group 35/38 (metal products, [electrical] machinery, transport equipment). It can even be seen that the gross value added of electrical engineering in 1960 according to the production statistics was higher than in the national accounts. This, in fact, reflects two different concepts of value added. The measurement of gross value added in the production statistics includes the cost of purchased services from outside the manufacturing sector. The national account concept of value added is net of costs of purchased services.

It is difficult to establish precisely how well the survey represents total manufacturing. Clearly, it tends to be biased towards the observed manufacturing groups in the 'sample'. For example, after the war the relative shares of textiles and wearing apparel in the national accounts decreased. Simultaneously, however, the coverage ratio of both groups was lifted substantially. This implies that the weighting given to both groups in the 'sample' of the survey is higher than the actual weight in the total manufacturing sector.

Therefore care has to be taken in assessing the significance of sample outcomes for the whole manufacturing sector in the national accounts.

3. Estimating real output and productivity

Measurement of real output and productivity falls into three general categories. The first is the physical productivity measures which show changes in the amount of goods produced per unit of labour. These are only appropriate if a relatively small number of items of a fairly homogeneous nature are involved, and if the production process is not too integrated. Most prewar measures are on physical output per person year or even per working-hour.[15] However, these measures only take technical efficiency into account and do not include inputs. The second category is the gross output and productivity measures, based on (deflated) gross production values. If appropriate price indexes are used, these measures take shifts in the relative importance of products and component sectors into account. However, they do not reflect changes in material requirements per unit of output. To measure real value added, the third category, net output and productivity measures, is needed. These measures also require information on materials consumed and, in the ideal case, appropriate input deflators to calculate real input.

Although the Central Bureau of Statistics compiled several price indexes (on raw material, wholesale and consumer prices) for the period after 1900, none were collected specifically for deriving real output indexes. They are not sufficiently detailed to relate to the values of output and input in question, and would have given unsurmountable problems of classification and weights if they had been used. An alternative method, which is used here, is the derivation of prices from the values and quantities which are obtained from the production statistics. The method involved is based on the industry-of-origin approach. This approach is especially fruitful in studies on international comparisons of real output and productivity based on production censuses.[16] In these studies price ratios for product samples compiled from the production statistics are used to construct a common currency. This common currency is then used to calculate real value added of the countries compared. By using the censuses instead of the national accounts

both output and input information for each country can be obtained from the same source. Prices are also obtained from the censuses by calculating unit values per product item.

For my research I did not compare output and productivity of two or more countries, but of successive years in one country. The method, however, was the same. One of the objects was to calculate appropriate unit value indexes. This procedure was accompanied by the usual problems of weighting, representativeness and consistency.

The general procedure is as follows. Indexes of output are calculated for each major group or group of industry by first constructing unit values for items in the survey for which data on both quantity and value are available. Next, the unit values for all the items of one industry (varying from one to five items) are current year weighted into a Paasche type of price index:

$$P_p^{uv} = \frac{\sum p_1 q_1}{\sum p_0 q_1} * 100$$

Within each industry there are generally some products for which no quantity or price information is available or for which output is negligible. Not all of the output value is represented by products of which both value and quantity data are available. I assume that the unit values of these products move in accordance with the weighted aggregative price-index of the known products. This procedure is better than one which assumes that changes in the volume of reported items represent changes in the volume of all items. The proportion of represented items is often subject to wide variations because of the introduction of new products or sharp changes in output of particular items.[17] Therefore the unit value indexes are limited in that only the primary products of each industry are included. For example, in 1938 the highest coverage percentages were found in the footwear-industry in which 99% of total recorded output was covered by products for which both quantity and price information was available, whereas in the machinery industry only 12% of the total output was covered.

To make allowance for new products and to tackle the problem of changing

quantities caused by changing relative prices, the period 1921-1960 was split up into sub-periods of five years each. So for every five-year period a new base year was created. Therefore particular products were able to be added to or left out the index. As a rule, only those products for which the output was larger than 3% of the total value of output were included in the price index. Finally, the sub-period series were linked at the overlap years at the beginning and at the end of the sub-periods. The deflation of the total money value of output by this current year weighted Paasche price index (based on the items for which both quantity and value were recorded) resulted in a base year weighted Laspeyres volume index, which is a conceptually desirable output index:

$$Q_L = \frac{\sum P_0 Q_1}{\sum P_0 Q_0} * 100$$

The calculation and weighting procedure of unit value indexes for the inputs was done in the same way as for the output index. Again, I included one to five different inputs per industry, for which data on quantity and value were available in the statistics. The constructed weighted price indexes were used to deflate the nominal input values of the various manufacturing industries resulting in Laspeyres volume indexes of inputs for each industry.

Where both the real output values and real input values were judged to be accurate enough for the measurement of an index of net output, the real input value was deducted from the output value according to the following formula associated with Fabricant and Geary [18]:

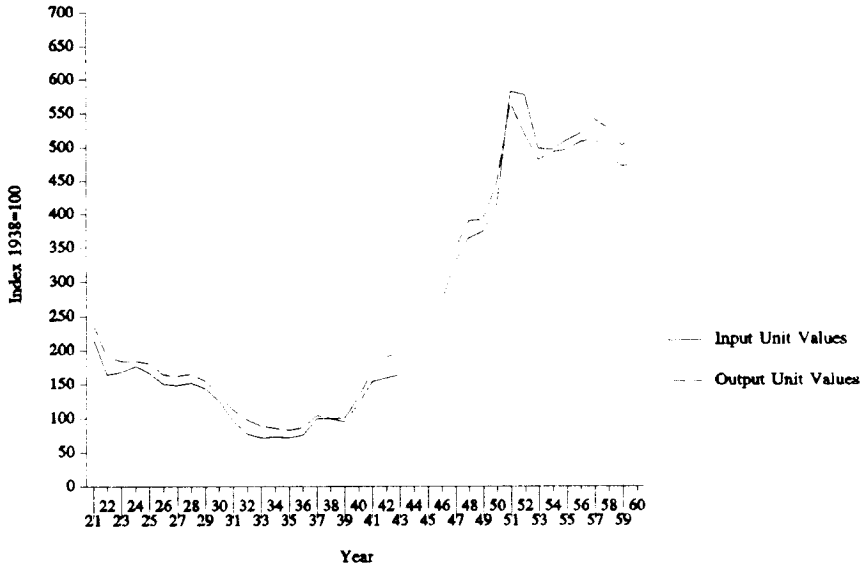
$$Q_L = \frac{\sum P_0 Q_1 - \sum p_0 q_1}{\sum P_0 Q_0 - \sum p_0 q_0} * 100$$

in which Q and P stand for the quantities and unit values of products (output) and q and p stand for the quantities and unit values of materials, fuel, and electricity consumed in the production process and other intermediate inputs. The outcome of this formula is an index of the constant price volume of gross value added. This real volume-index of value added can, for instance, be compared with an index on physical output, which is also a volume index. The difference between the two indexes is that the value added index is, by definition, a value index (in constant prices), not directly related anymore to physical quantities of output (for instance bicycles or ships). Variations of the index in time (when measured in constant factor inputs) point to changes in efficiency of production and changes in the production structure.

This double deflation technique, however, can give rather volatile results, especially when the ratio of input to gross output is high. The volume indexes can even produce negative results. This happens, for instance, if the constant price value of the inputs becomes higher than the constant price value of outputs. If input prices fall and consequently more inputs are consumed, the quantities will be weighted (according the formula) with base year prices, which are higher than current prices. This will result in a (too) high estimate of the real value of inputs, which in an extreme case can exceed the real value of output. In these circumstances an alternative procedure is to deflate value added in current prices with the output deflator. This method was introduced by Maizels who called it the 'modified net index'.[19] It is a single deflation of gross value added. The use of this method assumes that the prices or unit values for the inputs move in accordance with the compiled output unit values. Therefore changes in the structure of inputs are not measured.[20] However, in most cases it is very useful to calculate both single and double deflated gross value added (and productivity). As the former implicitly takes changes in volumes and relative prices into account, the latter registers only changes in volumes. Therefore comparison between the two indexes may reveal the consequences of changing relative prices.

4. Price indexes of input and output

To obtain one general input deflator and one general output deflator, the compiled input and output unit value-indexes of all the industries in the sample were aggregated into one 'sample' input and one 'sample' output series. This was done by weighting all input and output unit value-indexes with the value added share of each relating industry in the total sample value added.[21] Sub-periods of five years were constructed with changing value added weights linked at the overlapping years. Graph 1 shows the aggregated weighted input and output unit value indexes based on production statistics.



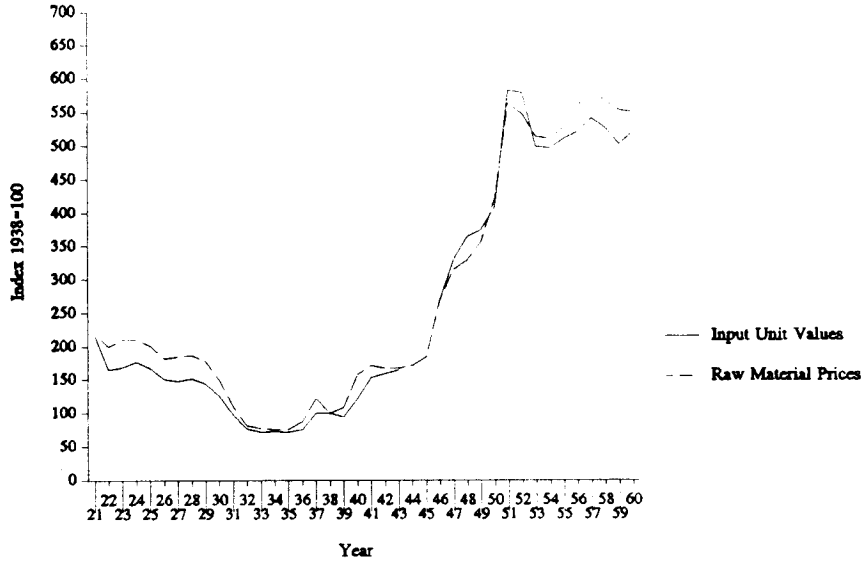
Graph 1: Unit values of input and output in manufacturing, 1921-1960. Weighted Paasche price indexes (1938=100).
Source: Appendix 2.

Several general remarks on the movement of both indexes can be made. From 1920 onwards unit values (or prices) declined very rapidly (after the postwar inflation, which is not shown in the graph). After the short depression of 1923, prices stabilized somewhat, but showed a slightly downward trend during the rest of the twenties. Prices which had

already declined in 1929 further decreased rather quickly until 1932. The absolute minimum was reached in 1935. Recovery occurred quickly after the abandonment of the gold standard in 1936. In 1938 and 1939 prices were at about the same level as at the beginning of the depression. Between 1939 and 1943 the unit values of both inputs and output increased quickly. The blank spots in 1944 and 1945 are caused by the fact that the CBS did not produce statistics for manufacturing during those years. After the war, prices went up at an enormous pace. The postwar period was characterized by scarcity of raw materials and final products. Prices reached a maximum during the Korean War in 1951. After this prices dropped, rose again after 1953 but declined in 1957 and 1958. Comparing the price level in the second half of the 1950s with the level in the 1930s, the conclusion is that the unit values of the sample increased fivefold within 20 years.

A comparison of both sets of unit values shows that the movements in the curves are almost similar. However, the index of output prices moves mainly above the input price index (1938=100). (Choosing another reference-year, for instance 1923, would, of course, influence these levels but not their relative positions.) Around 1925 the price level of output is less than 10% higher than the price level of inputs, but for 1932 this is more than 25%. For the Second World War period there is a widening gap between output and input unit values. After 1951, however, a reversal in the movement of the curves can be seen. Input unit values become higher than output unit values, 12% for 1952 and 10% for 1960. The effects of this change in relative prices is dealt with later in the article.

Graphs 2 and 3 compare both unit value indexes with the official price indexes of the CBS on raw material prices and on wholesale prices respectively. Compared to the input unit values, the raw material prices are continuously higher (1938=100), except for the period 1947-1952. More important, however, are the relative changes in the curves. For instance, in the beginning of the 1930s the raw material price index declines much faster than the unit value index. The difference between both indexes can be explained by the fact that the input unit values are based not solely on raw materials, but also on other intermediate products like ironware, sugar, yarn, cast iron and rayon. Furthermore, the CBS-index is based on raw materials for six groups of industry (wooden furniture, chemical products, textiles, leather, metalwares and paper), which do not correspond wholly with the materials in the unit value index.



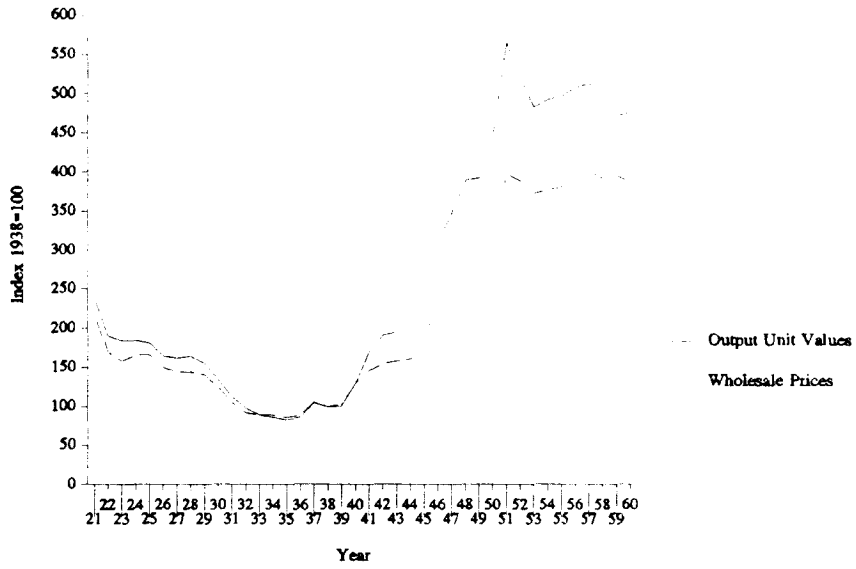
Graph 2: Unit value index of input items and CBS- index of raw material prices, 1921-1960. Index 1938=100.
Source: Appendix 2 and CBS, Zeventig jaren statistiek in tijdreeksen 1899-1969. ('s-Gravenhage 1970).

The same holds true for the weighting schemes. If the total input value of the sample industries were to be deflated with the 'official' raw material index, this would lead to a lower index of the real input volume and, subsequently, a higher index of real value added (apart from the period 1947-1952).

A comparison between the output unit values and the CBS wholesale price index (Graph 3) reveals much greater differences. Based on the reference year 1938, output unit values are higher than wholesale prices, except for the 1930s. For the war period wholesale prices are rather stable, whereas the unit value index shows a pronounced increase. For the period after the war the gap becomes even wider. Of course, it has to be borne in mind that both indexes are based on different sorts of products. The index of wholesale prices is an unweighted index based on finished products from eight groups of industries: glass, wood, chemicals, textiles, leather and rubber, metalwares, paper and foodstuffs. The unit value index is a weighted index of 32 intermediate and finished products from a

sample defined by the production statistics. But there is more to it than this. In the first place, instead of the unit values, which are ex-factory prices, the wholesale prices also include margins for transport and insurance. Furthermore, the wholesale price index embodies quoted, rather than actual, prices, and the two may differ. In times of shortages, premiums may raise actual prices above the published levels with the result that the index is understated. This probably explains the diverging developments between both indexes from 1940 onwards. The expansion of the money supply during the war years accelerated the rate of inflation. Actual ex-factory unit values increased more than wholesale prices. Although prices were strictly controlled from 1940 onwards stabilization occurred only after 1941 (and 1942 for the unit values).[22] Postwar scarcity lifted the rate of inflation. Again, ex-factory prices rose faster than wholesale prices. After 1952 both indexes show the same tendency.

Quite the opposite developments can occur when supplies are plentiful. In these circumstances the wholesale price index may be overstated because of the prevalence of discounts. Indeed, during the 1930s the unit values of the sample decreased faster than the wholesale price index. Finally, product mix shifts can also be responsible for discrepancies between unit values and wholesale prices.

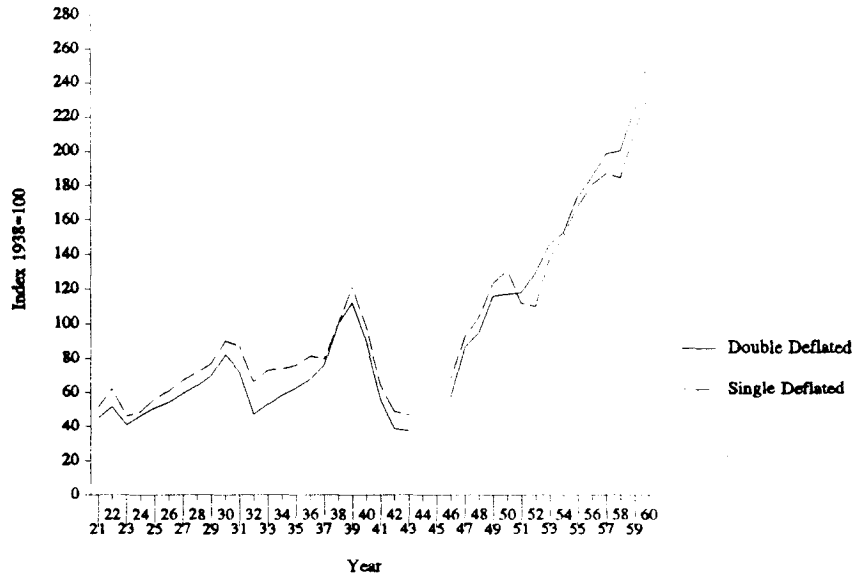


Graph 3: Unit value index of output and CBS-index of wholesale prices, 1921-1960. Index 1938=100.
Source: See Graph 2.

As already mentioned, the unit value index is based on five-year periods with diverging product items to allow for changes in the production structure. There is, however, no information on the consistency of products in the wholesale price index. Of course, there are some general limitations common to most price indexes which are not readily overcome. For example, it is generally impossible to express all of the changing qualitative aspects of the goods recorded in commodity specifications. Since price indexes tend to fail to allow for improvements in quality they are overstated and, if used for deflation, they result in an understatement of the real output value or the real value added. When quality deterioration occurs, for instance in wartime, the opposite tendencies prevail. One way to overcome this problem is to specify as many products as possible. If production, however, is very heterogeneous and the variation in prices is very large, it is better to calculate price indexes on the basis of some important products of known constant quality.[23] However, a more satisfying explanation for the observed disparity between both indexes cannot be given at this moment.

5. The deflation of gross value added

Ideally, in the measurement of net output, the volume of purchased business costs, along with materials, fuel and electricity, should be deducted from gross output. However, for the production statistics, no information was collected on purchases of business services such as advertising, insurance, transportation and communications. The usual term for this concept is 'census value added', but it is also sometimes referred to as 'net output'. Furthermore, no allowance was made for capital depreciation. Therefore the concept of value added is a gross concept. Graph 4 shows the real gross value added of all the manufacturing industries in the sample of the production statistics. Both double and single deflated value added are compared.



Graph 4: Real gross value added of the sample industries, 1921-1960. Double and single deflated. Index 1938=100.
Source: Appendix 3.

Gross value added increased about sixfold from 1921 to 1960. We have to remember, however, that not only economic but also statistical factors influenced this development. The number of industries in the sample increased, and this can only be corrected if the size of the labour force (dealt with later) is taken into account.

As with the development of prices, some phases in the development of value added can be discerned. From 1923 to 1930 value added increases steadily. After 1930 a rapidly downward movement occurs, but after 1932 growth rates are almost the same as before 1930, depending on the deflation technique used. The absolute peak is reached in 1939. From then on value added declines rapidly. For the period 1921-1939 growth rates of single and double deflated value added are 4.9 and 5.2% respectively (without 1939: 4.0 and 4.8%). The growth rate of real gross output is 4.6%. The higher growth rate of value added compared to gross output indicates that the relative share of intermediate inputs in gross output declined somewhat.

Estimates on manufacturing output performance, based on physical indicators,

show smaller growth rates. In a study covering 65% of manufacturing industry, Seegers found a growth rate of physical output of 2.9% between 1921 and 1938. This lower growth rate was mainly caused by the fact that Seegers's estimation begins from a relatively high level of output in 1921. CBS-estimates of physical output for the same period begin at a lower level. However, they show the same pattern as Seegers's figures, with a growth rate of 3.7%.[24]

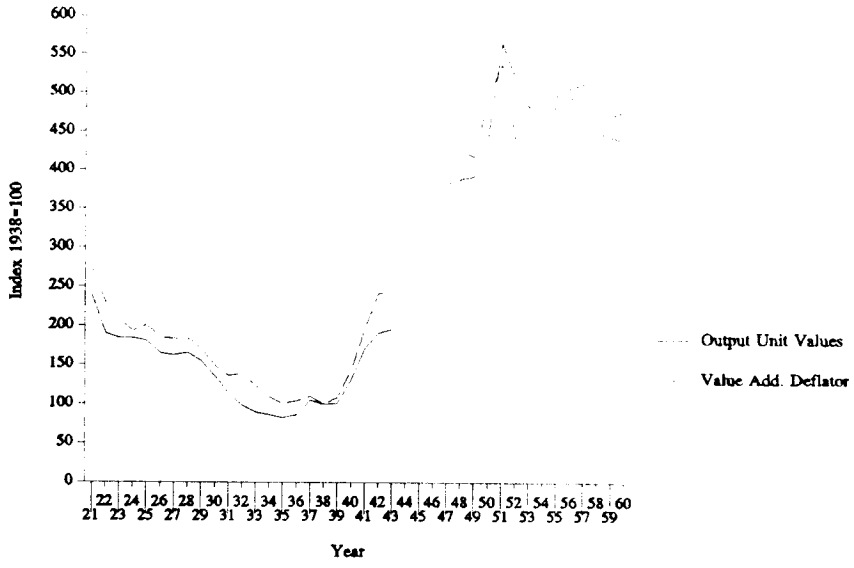
After the war growth rates of value added are significantly higher. The average growth rates for single and double deflated value added are 9.2 and 11.3% per annum respectively. Real gross output rises by 9.8% per annum. The annual growth rate of Dutch GNP in the period 1951-1963 was 4.4%.[25] This illustrates the large share of manufacturing in total GNP growth. For the period 1921-1960, single and double deflated value added growth rates are 3.9 and 4.5% respectively, and real gross output increases by 3.9% per annum.

Large differences exist between the single and double deflated value added figures. Although the lines are almost parallel, the double deflation line is significantly lower for the 1930s, catching up again with the single deflation line in 1937. Seen in dynamical perspective, the adjustment for the relatively low input prices reveals a significantly lower volume of real value added. This does not seem logical, because lower input prices should lift up profits. The decreasing real value added and the known decreasing level of profits in the 1930s suggest otherwise. The explanation for this apparent discrepancy is that real value added is a volume indicator and not an indicator of profits. Prices of raw materials are generally believed to change earlier and fluctuate more widely than prices of finished products, partly because wage costs are relatively rigid, and partly because profits and overhead per unit of output vary. Industries where there is some degree of monopoly tend to keep prices fairly rigid whether demand and production are falling or rising. This actually might have been the case in the 1930s. Not only were nominal wage costs fairly rigid, but there was also a strong tendency towards cartelization in the manufacturing industry, supported by the government.[26]

In the early postwar years real value added increases very rapidly. However, because of the low output level in 1946 it takes more than three years before the prewar level of 1938 is reached again. In contrast to this, CBS-reports state that the prewar level of manufacturing output had already been reached again by 1947. However, these

estimations only were based on physical output.[27] After 1950 the reversal in relative prices, that is the relative increase of input prices, indicates a faster growth of double deflated value added as against single deflated value added. Whereas single deflation indicates that there was an absolute decline of value added in 1951 and 1952 and a stabilization in 1957 and 1958, double deflated value added indicates only a declining growth of value added for both periods.

The index of double deflated value added multiplied by the nominal value added of the base year produces an 'implicit' real value added, that is the volume of net output in constant prices. With this it is possible to obtain an 'implicit' value added price index by dividing the nominal value added for each year (in current prices) by the real value added. Graph 5 presents this value added deflator, together with the output unit value index. The value added deflator takes both the fluctuations in the input and output prices (relative prices) into account. Obviously, the volatility of the value added deflator is much greater than the output deflator. For instance, the increasing gap between the input unit values and output unit values in the 1930s and during and after the Second World War results in a very high value added deflator. This has the effect of depressing the values of real value added rather heavily. After 1950 the reversal in relative prices drives the value added deflator to a level below the output deflator.



Graph 5: Index of output unit values and the implicit or value added deflator, 1921-1960. Index 1938=100.
Source: Appendices 2 and 3.

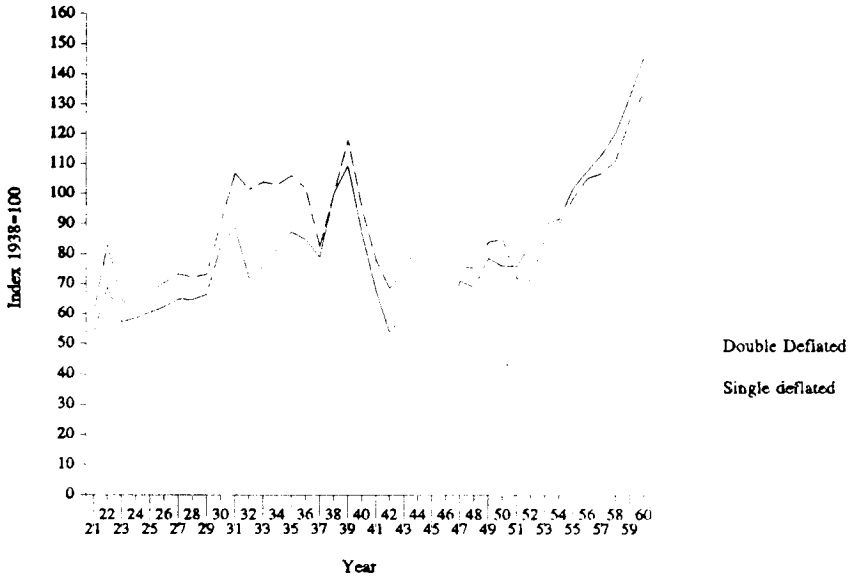
6. Developments in labour productivity 1921-1960

Productivity can be defined as the ratio of output to any related input or combination of inputs. In this section, output (in terms of value added) is related to labour input. If value added and employment are to be related, the classification basis for reporting the two sets of data should be the same. The Dutch production statistics contain information on the total number of persons employed per industry-branch per year. As a rule, employment was measured on 15th September each year. Because this counting date was the same every year, fluctuations in activity should also be revealed in these employment data, except for specific events such as strikes etc.

Unfortunately there were no annual estimates of average weekly working hours per industry before 1945. However, another source can be used to verify the data of the production statistics. From 1903 on, the accident statistics of the State Insurance Bank included information on the number of standard workers per group of industry, though the production statistics and accident statistics had no uniform classification system. A complete reconciliation between the two series has never been attempted. All that could be used were the employment data of the production statistics already mentioned. This partially offset the results of the elaborate and intricate process of calculating real value added. Therefore more care had to be taken in assessing the labour productivity values resulting from the production statistics. The index of real gross value added divided by the index of total persons employed (see Appendix 3) gives an index of real value added per person employed. In Graph 6 two series of labour productivity are shown, one single and one double deflated.

For the period before the Second World War double deflated labour productivity is far below single deflated productivity. Obviously this is caused by the fact that the input and output price indexes are different. For 1921 to 1939 single deflated productivity has an annual growth rate of 3.7% (1921-1938: 2.9%), double deflated productivity growth is 4.0% (1921-1938: 3.7%) These percentages are higher than comparable outcomes of contemporary estimates, based on physical indicators from various sources and on employment indexes taken from accident statistics already mentioned.[28] Average productivity growth for the period 1925-1935 can be estimated at 3% per annum. For the same period the single and double deflated productivity reveal growth of 4.7 and 3.8%

respectively. Van Zanden and Griffiths estimated growth rates of industrial productivity for the periods 1921-1929 and 1929-1939 at 3.3 and 2.5% respectively.[29] These estimates differ also substantially from the present estimates (for both periods double deflated productivity is 2.7 and 5.1% respectively). It is not clear, however, whether Van Zanden and Griffiths used current or constant prices in their estimation of output.



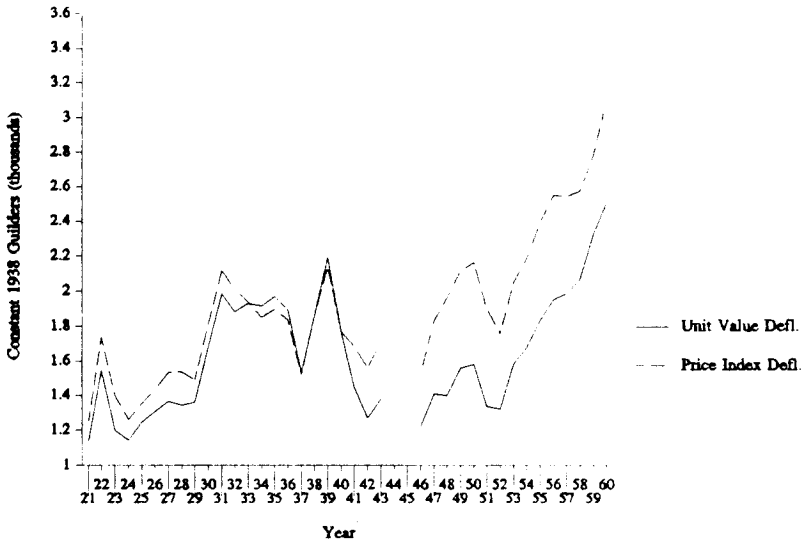
Graph 6: Real gross value added per person employed, 1921-1960. Double and single deflated, index 1938=100.
Source: Appendix 3.

For the 1930s especially, the graph shows large differences between double and single deflation. The level of single deflated productivity is much higher. This is probably overstating the 'real' productivity because the decline of prices of inputs relative to output prices has not been taken into account. Productivity declined in 1932, 1936 and 1937. Looked at in both ways, however, the trend in productivity increases considerably during the depression years. The steep productivity rise in 1930 and 1931 can be conceived as a swift defensive reaction to declining demand through doing away with less productive labour. Apart from price disparity, the difference between the two lines might also point to more structural changes in the production process in the sample industries, because of

changes in relative prices.

The rapid decrease of productivity during the Second World War is obvious from the graph. Because output unit values rose much more than the input unit values, double deflated productivity declined faster than single deflated productivity. The graph shows that in the postwar period labour productivity did not increase as fast as gross value added (see also Appendix 3). By 1949 real gross value added had already reached its prewar level. The growth of labour productivity, however, showed a different pattern until 1952. From Graph 6 it can be concluded that the prewar level (1938) of productivity was not reached before 1954 or even 1955. This seems to be rather late. To discover whether this low productivity outcome was caused by the constructed unit value index, a comparison was made between the single deflated productivity of Graph 6 and real productivity obtained from the CBS wholesale price index. Graph 7 shows that in 1946 the former begins from a much lower point than the latter. Also growth rates are lower in the initial years. Remember that the CBS wholesale price index is much below the output unit value index for these years (Graph 3). Because of this, the prewar productivity level using the wholesale price was reached in 1947, although it fell back again in the early fifties.

The problem faced with has already been dealt with in Section 5. Large disparities occurred between 'official' prices which were fixed by the authorities, and unit values, which were more influenced by scarcity and therefore driven upward much faster. In view of this price disparity, it is very difficult to establish a 'true' and consistent price index which covers both the war and postwar years. The quality problem has to also be mentioned for the postwar years. To the extent that the quality of some products has improved, which of course was almost unthinkable so shortly after the war, the output and productivity series will have a downward bias if intrinsic quality changes are not met in the unit value index. The same applies, however, for the wholesale price index.



Graph 7: Real gross value added per person employed, 1921-1960. Single deflated with output unit values and with wholesale prices from the CBS. In constant 1938 guilders (thousands). Source: See Graph 2 and Appendix 3.

The retardation in productivity growth (relative to output growth) in the sample industries is confirmed in the literature. Brakel found that industrial labour productivity did not equal the prewar (1938) level before 1953. CBS statistics on physical productivity in manufacturing also suggest a return to the prewar (1938) level in 1953.[30] De Vries explained this retardation by referring to delayed replacement of machinery during the German occupation and to the scarcity of raw materials and intermediate inputs.[31] Brakel also mentioned the influence of the Korean War boom in encouraging employers to hire more workers. This however, had a depressing influence on average productivity. During the mild recession in 1952, employment declined.[32] After 1952 an unprecedented growth of productivity set in, which lasted throughout the decade. The calculated annual growth rate of productivity for the period 1952-1960 was slightly less than 8%, approaching the growth rate of real value added.

7. Conclusions

This article presents real output and productivity estimates of Dutch manufacturing, based on production statistics. The process of industrial development can be described and analysed quite accurately, because the statistics are not confined to a few benchmark years but produce annual data. The most important advantage of computing net output or value added indicators is that they also provide an excellent check on the adequacy of the basic data. If they are compared to indexes of labour input, materials used, and gross output, they permit a critical examination of related industrial statistics and play an important part in the improvement and integration of these basic data. However, more certainty is needed on the representativeness of the sample industries in relation to the total sector.

To deflate values of inputs and outputs, special unit values were constructed from the production statistics and aggregated into a weighted index. Both input and output indexes were limited in that only the primary products of each industry were included. Nevertheless, they produced satisfying results, both for single and double deflation. Comparison of both indexes with the CBS raw material price index and the wholesale price index respectively showed rather large differences, especially for shortly before and after the Second World War. Since price indexes are an indispensable instrument for linking the prewar and postwar output and productivity performance, price developments in this period need more investigation.

Appendix 1.

Manufacturing industries in the Dutch production statistics 1921-1960.*

Major group	Group	Period
20/21 Food, beverages, tobacco	20.4 Flour mills	1921-1960
	20.6 Margarine works	1921-1960
	20.7 Vegetable and foodproc.	1937-1960
	20.9 Cocoa and chocolate	1921-1960
22 Textile industry	22.1 Woolspinning/weaving	1921-1960
	22.2 Cotton industry	1921-1960
	22.3 Hosiery, knitted goods	1921-1960
	22.5 Carpets industry	1934-1960
	22.9 Man. of narrow fabrics	1930-1960
23 Wearing apparel	23.1 Ready-made clothing	1933-1960
24 Leather,footwear	24.1 Leather factories	1928-1960
	24.3 Shoe factories	1921-1960
26 Paper, paper products	26.1 Paper mills	1921-1960
29 Chemicals	29.7 Soap factories	1921-1960
31 Rubber, synthetics	31.1 Rubber products	1921-1960
32 Building materials etc.	32.1 Bricks/roofing tiles	1934-1960
	32.2 Earthenware	1937-1960
	32.3 Sand-lime bricks	1934-1960
34 Metal products	34. Hardware/holloware/stoves	1921-1960
	34. Wire-industry	1921-1960
	34. Steel furniture	1933-1960

35 Machinery	35. Mechanical engineering and construction	1921-1960
36 Electrical machinery	36. Electr. engineering	1921-1960
37 Transport equipment	37.2 Motorcars	1934-1960
	37.4 Shipbuilding	1921-1960
	37.6 Bicycles	1921-1960

* Only those industries that were covered in the survey both prior to and after the Second World War are mentioned here. See also Section 2.

Appendix 2. Unit values of inputs and output, 1921-1960.

Weighted Paasche price indexes (Index 1938=100)

Year	Unit Values of Inputs	Unit Values of Output	Year	Unit Values of Input	Unit Values of Output
1921	215.6	238.4	1941	153.4	171.1
1922	164.4	190.3	1942	159.1	191.0
1923	168.1	184.2	1943	164.5	195.6
1924	176.6	184.5	1944		
1925	166.9	181.2	1945		
1926	150.1	164.6	1946	269.3	309.3
1927	147.9	162.4	1947	330.2	346.5
1928	151.7	165.3	1948	364.2	389.7
1929	143.6	155.1	1949	373.7	391.9
1930	125.6	134.8	1950	408.5	445.0
1931	97.3	112.6	1951	582.4	565.5
1932	76.9	97.9	1952	577.7	518.5
1933	71.5	89.3	1953	498.0	481.9
1934	72.6	85.9	1954	496.1	492.4
1935	71.9	82.9	1955	509.4	496.2
1936	75.4	86.2	1956	519.9	507.1
1937	100.1	104.7	1957	540.2	512.3
1938	100.0	100.0	1958	527.3	487.9
1939	94.8	100.3	1959	501.4	471.0
1940	122.1	130.8	1960	519.8	476.2

Source: Calculated from the Dutch Production Statistics.

CBS Maandschrift (1921-1952), CBS Produktiestatistiek (1953-1960)

Appendix 3. Gross value added of the sample industries (see Appendix 1) Double and single deflated, employment and productivity. (Index 1938=100).

Year	Employment	Gross V.A. Double Deflated	Gross V.A. Single Deflated	Lab. Prod. Double Deflated	Lab. Prod. Single Deflated
1921	84,3	45,1	51,5	53,5	61,1
1922	74,7	51,4	62,1	68,9	83,1
1923	71,2	40,8	46,0	57,3	64,6
1924	78,8	46,1	48,4	58,5	61,4
1925	83,7	50,6	56,2	60,4	67,1
1926	86,3	53,8	60,7	62,4	70,3
1927	91,2	59,1	66,9	64,9	73,4
1928	99,0	64,1	71,6	64,7	72,3
1929	105,0	69,7	76,8	66,4	73,2
1930	99,5	82,1	90,1	82,6	90,5
1931	81,4	72,3	86,9	88,7	106,7
1932	65,6	47,1	66,4	71,8	101,2
1933	70,0	52,9	72,7	75,6	103,8
1934	71,8	58,6	73,9	81,6	103,0
1935	71,7	62,6	76,0	87,3	106,0
1936	79,8	67,6	81,2	84,7	101,8
1937	96,2	75,9	79,3	78,9	82,4
1938	100,0	100,0	100,0	100,0	100,0
1939	102,6	112,2	121,0	109,3	117,9
1940	102,8	89,0	97,6	86,6	95,0
1941	81,9	55,5	63,9	67,7	78,0
1942	71,1	38,4	48,6	54,0	68,4
1943	62,5	37,4	46,5	59,8	74,3
1944					
1945					
1946	103,1	56,7	67,8	55,0	65,8
1947	121,7	86,4	92,4	71,0	75,9
1948	137,8	94,8	103,6	68,8	75,2
1949	147,2	115,7	123,4	78,6	83,8
1950	153,8	116,9	130,7	76,0	85,0
1951	155,6	117,6	111,8	75,6	71,9
1952	154,6	129,1	109,8	83,5	71,0
1953	161,7	145,4	137,7	89,9	85,2
1954	167,0	152,9	150,4	91,5	90,1
1955	170,5	173,6	168,2	101,8	98,6
1956	171,9	185,2	180,5	107,7	105,0
1957	175,1	198,2	186,9	113,2	106,7
1958	165,8	199,8	184,3	120,5	111,1
1959	168,6	224,0	210,9	132,8	125,1
1960	173,2	252,9	232,7	146,0	134,4

Source: Calculated from the Dutch Production Statistics.
CBS Maandschrift (1921-1952), CBS Produktiestatistiek (1953-1960).

1. L. Rostas, Comparative Productivity in British and American Industry (Cambridge 1948).
   L. Rostas, Productivity, Prices and Distribution in Selected British Industries (Cambridge 1948).

2. S.N. Broadberry and N.F.R. Crafts, 'Explaining Anglo-American productivity differences in the mid-twentieth century,' Oxford Bulletin of Economics and Statistics 52 (1990) 375-402.
   S.N. Broadberry and R. Fremdling, 'Comparative productivity in British and German industry 1907-37,' Oxford Bulletin of Economics and Statistics 52 (1990) 403-421.
   R. Fremdling, 'Productivity comparison between Great Britain and Germany, 1855-1913,' Scandinavian Economic History Review 39 (1991) 28-42.

3. B. van Ark, International Comparisons of Output and Productivity. Manufacturing Productivity Performance of Ten Countries from 1950 to 1990 (Groningen, Groningen Growth and Development Centre Research Monograph no.1, 1993).

4. For a brief overview see J.J. Seegers, 'Produktie en concurrentievermogen van de Nederlandse industrie in het Interbellum', Economisch- en Sociaal-Historisch Jaarboek 50 (1987) 186-211.

5. F.A.G. Keesing, De conjuncturele ontwikkeling van Nederland en de evolutie van de economische overheidspolitiek 1918-1939 (Nijmegen 1978, 1st pr. Utrecht 1947), 26, 76, 117, 174, 250.

6. See note 5.

7. J.L. van Zanden and R.T. Griffiths, Economische geschiedenis van Nederland in de 20e eeuw (Utrecht 1989) 116, 117, 154, 156.

8. See CBS, 'Index numbers of industrial production in the Netherlands', Statistical Studies 19 (The Hague 1967).

9. See F.J.C. van der Schalk, De wiskundig-statistische analyse van de arbeidsproductiviteit en haar practische toepassing op eenige bedrijfstakken en ondernemingen in Nederland (Haarlem 1938). CBS, Onderzoek naar het verloop van de arbeidsproductiviteit ('s-Gravenhage 1939).

10. CBS, 'Ontwikkeling van de produktie per werknemer in enkele bedrijfsgroepen', Statistische en econometrische onderzoekingen 13 ('s-Gravenhage 1958) 181-192.

11. CBS, 'Statistiek van de voortbrenging en het verbruik der Nederlandsche nijverheid in 1913 en 1916', Bijdragen tot de Statistiek van Nederland 292 ('s-Graven-

hage 1920).
CBS, 'Statistiek van de voortbrenging en het verbruik van een aantal takken der Nederlandsche nijverheid in 1919', Bijdragen tot de Statistiek van Nederland 322 ('s-Gravenhage 1921).

12. CBS, Maandschrift, Vol.16 (1921) - Vol. 48 (1953).

13. CBS, 'Het nationale inkomen van Nederland 1921-1939', No 7 der Monografieën van de Nederlandse Conjunctuur (Utrecht 1948).
CBS, 'De nationale jaarrekeningen: doeleinden, problemen, resultaten', No 8 der Monografieën van de Nederlandse Conjunctuur (Utrecht 1950).
G.P. den Bakker, T. A. Huitker and C.A. van Bochove, 'The Dutch economy 1921-39: revised macroeconomic data for the interwar period', Review of Income and Wealth 36 (1990) 187-206.

14. The leaving of indirect taxes embodied in the values means that they are also embodied in the derived price (=unit value) deflators. In this way every tax-caused change in the value of produced or consumed commodities will be neutralised in the deflated, constant-price values.
Output, input, and productivity measurement (Princeton 1961) 214.

15. The first estimates on output and productivity in Dutch manufacturing industry were made by Van der Schalk and by the CBS: Van der Schalk, De wiskundig-statistische analyse, CBS, Onderzoek.
The CBS has also published quantum indexnumbers of industrial production from 1921 onwards. See f.i. J.B.D. Derksen, 'Indices van de industrieele productie van Nederland', De Nederlandsche Conjunctuur (1939) 45-51. CBS, 'Indices van de industriële productie van Nederland', Statistische en Econometrische Onderzoekingen 1 no 3 (1946) 34-36, and CBS 'Index numbers of industrial production in the Netherlands', Statistical studies 19 (1967). For the period 1921-1938 Seegers produced new indexes on output per major group of industry, mainly based on the CBS production statistics. Some estimations are based on value added. J.J. Seegers, 'Produktie'.

16. For instance the project on the international comparisons of output and productivity at the University of Groningen. See B. van Ark, 'The ICOP approach - its implications and applicability', Explaining Economic Growth, Essays in Honour of Angus Maddison (North-Holland 1993) 375-398.

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